Modern Computational Accelerator Physics

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Fermilab

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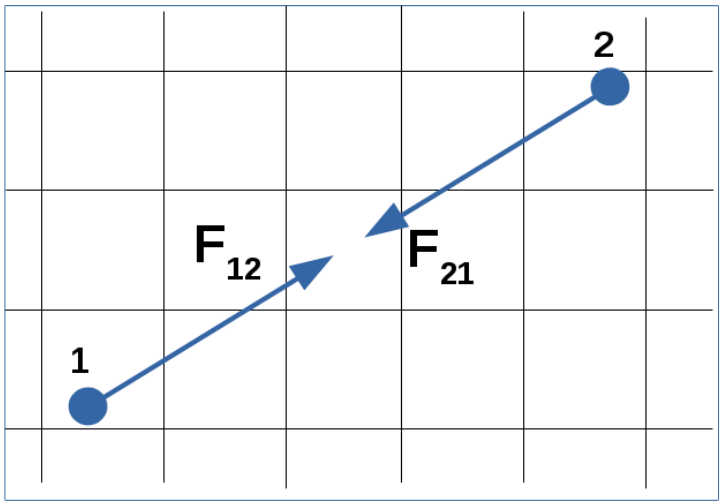
2D Rectangular space charge solver (continued)

Electric field interpolation and the space charge kick

- Make sure the charge deposit and field interpolation do not introduce spurious forces.
  - The sum of the reciprocal forces between any two particles should be zero for open boundary conditions.
    - $F_{12} + F_{21} = 0$



2D solver with rectangular boundaries

- Download *space_charge_rectangular.py*
- The method *apply_kick(bunch, Ex ,Ey, time_step)* is the last ingredient to our solver.
- Notice that the kick magnitude is modulated by the longitudinal line charge density.

Assignment 1

- Using the script *space_charge_sim.py* run synergia simulations for *foborodobo32.lat* lattice.
  - Add a new diagnostic per turn which measure the beam mean and size (Diagnostics_full2).
  - Track at least five particles with the track diagnostic.
  - Run 5 simulations with 1000 turns such:
    - One without space charge.
    - For each case characterized by 10e9, 10e10, 10e11 and respectively 10e11 real particles per bunch run one simulation.
    - Be careful not to overwrite the diagnostics files.

Assignment 2

- Analyze the diagnostic files.
- Using as example the script *incho_tunes.py* analyze the tune spectrum of the particles in the track diagnostic files.
  - Do you notice any difference when increasing the space charge effects?
- Using as example the script *diag_analysis.py* analyze the coherent tune (the tune of the mean), and the beam size (standard deviation) as a function of the beam intensity.
  - The space charge solver used here has open boundary conditions. What should happen with the coherent tune of the beam when the beam intensity is increasing?